User's Guide for GOES-R EUVS L2 Products

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1 Summary

The GOES-R Extreme Ultraviolet and X-Ray Irradiance Sensors (EXIS) Extreme Ultraviolet Sensor (EUVS) Level 2 (L2) data is based on the high-cadence extreme ultraviolet irradiance measurements in the EUVS Level 1b (L1b) data. EXIS was designed and built by the Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado Boulder. The data is produced by NOAA's National Center for Environmental Information (NCEI) in netCDF data format and is similar to the operational product used at the NOAA Space Weather Prediction Center (SWPC).

This User's Guide provides descriptions of the L2 algorithms (Machol et al., 2020). Caveats for the operational EUVS L2 data are given in the Readme at https://www.ngdc.noaa.gov/stp/satellite/goes-r.html.Users of the GOES-R EUVS data are responsible for inspecting the data and understanding the known caveats prior to use. Technical questions about this data can be sent to *janet.machol@noaa.gov* or *courtney.peck@noaa.gov*, while data access questions should be sent to *pamela.wyatt@noaa.gov*.

2 EUVS L2 Products Overview

GOES-R EUVS (Eparvier et al., 2009; Snow et al., 2009) makes extreme ultraviolet (EUV) and far ultraviolet (FUV) high-spectral-resolution measurements of distinct solar emission lines representative of different layers of the solar atmosphere. EUVS measurements are made for seven solar lines and the Mg II core-to-wing ratio (Mg II index) as shown in Table 1. An EUV spectrum from 5 to 127 nm is constructed from the EUVS measurements using an empirical proxy model (Thiemann et al., 2019). The model outputs solar spectral irradiance (SSI), i.e., the solar irradiance as a function of wavelength, which is used in conjunction with absorption cross sections that are a function of wavelength and altitude as inputs to atmospheric models (e.g., Solomon and Qian, 2005). Irradiance values are as measured at that satellite; conversion factors are provided in the files for users who wish to convert to irradiance at 1 AU.

Table 1: Main Solar Lines Measured by EUVS

Wavelength (nm)	Lines(s)	Source Region
25.632	He II	Transition region
28.415	Fe XV	Corona
30.378	He II	Transition region
117.5	C III	Chromosphere
121.567	H I	Transition region
133.57	C II	Chromosphere
140.5	Si IV, O IV	Transition region
279.5528, 280.2704	Mg II h, k	Chromosphere

* The Mg II index is derived from measurements near 280 nm.

The EUVS L2 products are listed in Table 2. Two products are currently available and more will become available later this year.

Table 2: EUVS L2 Products

Product	Name	Description	Available Now
high resolution	hires	irradiances, currents at highest resolution	
1-min averages	avg1m	irradiances, MgII index, spectral model at 1-min cadence	x
daily averages	avg1d	daily averages of irradiances, MgII index, spectral model	x
flare summary	flsum	flare detection flags such as start and peak	
flare detection*	fldet	flare detection status for every minute	

* Most users should use the flare summary instead of the flare detection product. See warning in Section 5

2.1 Science-Quality versus Operational EUVS Data

The science-quality L2 data products differ from the operational L2 products used in operations at SWPC in completeness and quality. The science-quality data incorporate the most up-to-date calibrations and algorithm fixes and they are reprocessed since the start of the mission. The science-quality L2 data products are created from the science-quality L1b data. Both the science-quality and the operational data include some recovered data that was missing in the real-time operational products. The operational L1b and L2 data, especially from the earlier dates, contain significant issues that are not retroactively corrected, and therefore should be used with great caution and not for scientific analysis.

The science-quality data directories have names which end in "_science" and the file names have prefixes of "sci_". The science-quality data has a latency of three days.

The operational data are in directories without the "_science" suffixes, and the operational filenames have prefixes of "ops_" for L1b data and 'dn-' for L2 data. The operational data can be accessed from the parent directories of the science-quality data. This data has a latency of one day.

3 1-minute Averages Product

This product contains the 1-minute averages of the L1b data. The wavelengths of the associated low and high bandpass cutoffs as well as the line center are provided. Irradiance values scaled to a 1-nm bandpass are also provided for the 28.4, 30.4 and 121.6 nm lines.

Flags are provided which state the status of the averaged irradiances. There are only four flag meanings as shown in Table 3. Additionally, the unions of flags set for data excluded from the averages are provided. There is also a flag which is set for 8 hours around local midnight when the Lyman-alpha (121.6 nm) measurements will be impacted by geocoronal absorption.

The spectral model provides 1-minute time averages of the EUVS solar spectral irradiance model. There are 22 model bands with a 5-nm bandpass from 5 to 115 nm, and a 23rd bin from 117 to 127 nm. The spectrum is created based on the available EXIS data which is flagged by the model_case_flag which ranges from 1 to 8.

Table 3: Status flag states for 1-min irradiance averages.

Flag	Description
good_quality	none of eclipse, lunar_transit or bad_or_no_data flags are set
eclipse	Earth eclipse
lunar_transit	lunar transit
bad_or_no_data	pointing error, missing data, or otherwise bad data

4 Daily Average Product

This product consists of daily averages of the 1-minute averages. The daily average only includes 1-minute data where the good_quality flag is set. For the 121.6-nm line, the daily average excludes 6 hours around local midnight in order to exclude impacts of geocoronal absorption.

5 Flare Summary and Flare Detection Products

These products are under development and will provide information on EUV flares including start, peak and end times, integrated flux, and background flux based on 1-minute EUVS irradiances. Information is provided for flares at 28.4, 30.4 and 121.6 nm. The flare detection product provides output every minute while the flare summary product provides records only for four most important states. Table 4 shows the available status flags for the two products.

Table 4: Status Flags for Flare Summary and Flare Detection Products

Flag	Description	Summary	Detection
MONITORING	There is no event in progress.		X
EVENT_START	A flare has just started.	X	X
EVENT_RISE	Flare has started but not reached its maximum.		X
EVENT_PEAK	Flare maximum.	X	X
EVENT_DECLINE	Flare has begun to decay.		X
EVENT_END	Flare has declined to 1/2 of flare maximum.	X	X
POST_EVENT	Flare declined to background.	X	X
IMPAIRED	Algorithm has insufficient data to determine status.		X

For most users, the flare summary product should be used and the flare detection product should not be used. The flare summary provides true time stamps of events. The flare detection algorithm must detect the flares in real-time operations, and the detection of the start of the event is typically determined before the flare peak.

The flare detection time stamps represent the time that the algorithm detected an event such as the flare peak, rather than when the actual peak occurred. For some event types such flare peak, this results in flare detection time stamps that are delayed by several minutes. The flare detection product is provided for users who wish to examine the algorithm behavior. The event detection product is used in real-time forecast operations, where minute-to-minute status information is the priority.

6 High Resolution Product

This product is under development and will provide higher time and spectral resolution diode currents and irradiances.

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8 References

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